Section 1: Parts A-G *(Help/Journal Answers)*

Using Quorum Commands to take Images with Telescopes in Skynet

A) Introduction

The introduction talks about why asteroids are studied. It then gives an idea of what section 1 is about.

B) Skynet Telescopes and CCD Cameras

This part starts out with two videos. Please watch!

Use the JOURNAL BOX below to answer these questions

1. What was Skynet's original purpose?

2. Why are telescopes spread out around the world?

3. Why are some in the northern hemisphere and some in the southern hemisphere?

1. **When a Gamma-Ray burst is detected by the space telescope, these ground based optical telescopes will immediately slew to the general position of the burst to get an optical image.**
2. **Gamma-Ray bursts can happen anywhere in space.**
3. **Remember, optical telescopes can only image at night time, so the network covers most of the night sky.**

1) ACTIVITY: Skynet Telescopes

This activity is useful for both sighted and BVI students

Use the JOURNAL BOX below to answer the following questions.

4. What hemisphere is the Cerro Tololo observatory in?

5. What does longitude mean? (There will be more on this later)

6. What is the longitude of the Cerro Tololo observatory?

4. **This is referring to the Prompt6 Telescope (at the Cerro Tololo Inter-American Obs.) used in this Exploration. Cerro Tololo is in the southern hemisphere.**
5. **Longitude is the distance (as an angle) between a specific point on the Earth's surface and the prime meridian in Greenwich England.**
6. **Cerro Tololo is 70.8063 degrees West.**

2) CCD CAMERAS

At the beginning of this Exploration there were several worthwhile activities. The CCD camera activity is one of these. The link listed in this part on the SJS webpage will take you back to the activity. In the video, Dr. Al Harper reviews the CCD camera and gives another perspective.

Use the JOURNAL BOX below to answer the following questions.

7. What part of your eye acts like a light "detector" or pixel?

8. How does Dr. Harper simulate measuring the number of electrons each detector (pixel) has collected?

9. Why is it impractical to collect light one pixel at a time?

7. *Your retina acts as a light detector.*
8. *Dr. Harper uses an electronic scale to measure the weight of the pennies collected in the cup.*
9. *If each pixel needed 10 minutes to collect energy, and you had to do it consecutively, the total time gets too long. A 2D array, where all the pixels collect light at the same time alleviates this problem.*

C) Quorum Computer Language Part 1

(VIDEOS are provided by Chris Matthews to help with the concepts encountered in Quorum.)
This is a LONG Part!
This is the students first encounter with Quorum. The hardest thing will be navigating between the Quorum Box and the instructions.
*Note: In the resources there is a PDF (downloaded from a text file) of the Quorum commands used in this PART.

A) COMMANDS: say, output

(**The say command may have an issue with the Chrome browser. If it is not working for any of your students, have them use Firefox.**)
Experiment with the Quorum Box and the say and output commands.
Make sure the students understand the two notes in the Exploration about the Quorum Box and the controls below the box
The "Challenge" is pretty easy.

B) DATA TYPES and VARIABLES

Activity #1 Is a game to learn about variables, Activity #2 combines variables together in output and say statements, and Activity #3 is an optional challenge exercise.

Variable types, especially a boolean, can be tricky for students. Chris and Tyler do a nice job in the video explaining these.

The game helps them become more comfortable. Make sure to watch the video for help with the game.

The instructions for the "Go Code" game are listed here (and also within the text on the web page):

Go Code/Go Fish Instructions
Go Code/Go Fish CARDS

This next link is a Challenge activity that is optional (the link is also in the Exploration). It has journal questions that can be added into the same journal box they used in the above parts. Suggested answers are listed below.

 Link - CHALLENGE! Activity 3 for Data Types and Variables:

> 10.   Were you able to run the code correctly the first time? If not, what rules of coding did you learn from your mistakes?
>
> 11. In the "Go Fish" game we played in the previous activity, you learned how to define variables. What is the trickiest part of defining variables?
>
> 12.   What was the purpose of the underscores in the first section of the challenge?
>
> 13.   Why were '+' signs added in the output blocks? Come up with a group consensus on their purpose.
>
> 14.   Were there any improvements your group made? Explain them in the journal box.

10. Making mistakes is important - talk about this with the group! Share mistakes!
11. Come up with a group consensus. They will probably find that giving names to variables has some rules, like no spaces!
12. The use of the "underscores" - they can use a two word variable, but there must be an underscore between the words, not a space.
13. "+" signs simply allow variables to be put together, whether its text or integers or numbers. They should come up with an example of each.
14. Give suggestions for the activities.

C) RULES and OPERATIONS for VARIABLES

Chris gives a nice explanation in the video.

The two Quorum activities, #4 and #5 are similar - one should be an easy math problem, and the other should be harder.
The students will have to add commands to the few given on the SJS portal. Output or say will be needed, along with other variables defined. The math operations are addition (+), subtraction (-), multiplication(*), and division(/). Parentheses can be used for order of operations. The goal is for experimentation! The students should run into problems with the use of integer variables. If answers have decimals, what does Quorum do to record it as an integer? This should produce a good discussion. The use of a calculator to compare to Quorum's answers is useful!

Part D - Quorum Computer Language Part 2

Again, a PDF of the text file of commands is available in the resources.
Chris also helps explain concepts with his videos.

A) COMMAND: input

Finally a way to input information from a user into Quorum! The students should study the example command line that is given. Then they should type it in, and then change it for more fun as instructed! Copying the code into the Journal Box just saves it for reference.

TEXT STRINGS

The first part just has the student think about user friendly output or say statements. Again, practicing helps them refine their technique. Don't forget parentheses!

B) COMMAND: cast

The "cast" command is very useful since all input statements Quorum reads as text. Many times that text has to be changed to a number variable so operations, etc. can be done. They should type it in as it is on the page to get familiar with it. Then output or say the result.

C) Using Computational Thinking

This is a nice activity for the students to use the knowledge of Quorum they learned so far. This is a link to some example solutions:
 [Script for Meteor hitting house](#)
Encourage group discussion and solutions. Have different groups show what they did differently.

a) How many variables of each type did you use?

b) What was the hardest part of this coding problem?

c) What did you need to change to make it work for anything in the solar system?

These journal questions should help them reflect on their thinking process.

Part E - Conditional Statements in Quorum

Chris does a nice job introducing the concept in the video.
The first part is about boolean conditional statements. They need to try the example. There is a warning about copying and pasting, sometimes a blank doesn't copy as a blank!
The second part is about conditionals that can test multiple statements - an elseif statement. Again, practice is critical!
Use the Journal Box for whatever you would like.
Here is the online Quorum tutorial if needed:
https://quorumlanguage.com/tutorials/language/if.html

Part F - Orbital Elements of Asteroids

The main objective in this part is to have the students brainstorm about what is needed to determine where an asteroid is in its orbit at any given moment. The specific answers will be talked about in Part H, Commanding a Telescope to take an Image. The students will have the opportunity to demonstrate the orbital elements using a large hoop.

ACTIVITY: Ellipses

Kate, from GLAS education, explains the properties of an ellipse in the video.
The people demo for this works well. The instructions are in the Exploration.
Have the students work on the vocabulary words as they do the demo. Then they can make the measurements asked for.
Using the data given about the planets, the questions at the end of Part F will help to synthesize their knowledge.

JOURNAL Questions (use any resource)

6. What is the eccentricity of a circle?

7. Which object in the solar system has a path closest in shape to a circle?

8. Which is the most eccentric?

9. What is your guess about the eccentricity (shape) of an asteroid's orbit?

10. In conclusion, does a smaller eccentricity mean the shape is more elliptical or more circular?

6. Zero
7. Venus
8. Pluto
9. Very eccentric!
10. A smaller eccentricity means the shape is closer to a circle.

Part G: Classify an Asteroid's Orbit

This part asks the students to put together a lot of the knowledge they have gained so far about astronomy and Quorum. Working in groups should alleviate some fear.
Have them define aphelion and perihelion before writing the script.
Here are example scripts:

Possible Scripts for Asteroid Classification

ACTIVITY: Classify These Asteroids:
This part simply uses the script written above. They are verifying the orbits of these known asteroids.
They can find the answers on Wikipedia. The script is just verifying these.
A) Main Belt, B) Main Belt C) NEA D) Mars Crosser E) Main Belt

A.) Asteroid: 1 Ceres

B.) Asteroid: 4 Vesta

C.) Asteroid: 2012 TC4

D.) Asteroid: 3200 Phaethon

E.) Asteroid: 4933 Tyler Linder

IDATA

Innovators Developing Accessible Tools for Astronomy